14 January 1963
LEC:mb-35

Chief, Office of Naval Research
Department of the Navy
Washington 25, D. C.

Attention: Code 414,

Subject: Contract
Proposal for Extension of Perceptron Applicability to Automatic Photo-Interpretation

Enclosure:
(1) Technical Proposal
(2) Estimated Cost Breakdown
(3) Certificate of Current Pricing Data
(4) No-Contingent Fee Statement

Dear Sir:

As a result of our recent presentation at ONR on research to date under the subject contract and your invitation, we are pleased to submit a proposal for additional research effort on the applicability of perceptrons to photo interpretation. Our efforts to date have generally confirmed the validity of the system philosophy being planned and have provided evaluation of a number of techniques for accomplishing the various steps of object processing in an automatic system.

Our proposal for continuing effort under Contract offers three alternate programs at varying levels of scope and funding. Briefly and for clarity, these program alternates are defined as follows:

A. Optimum Program - to be performed in a 12-month period from date of authorization to proceed, and to include the following efforts:

1) Additional study of automatic photo interpretation concepts, utilizing the IBM 704 computer including:

(a) Further investigation of techniques for object detection.
(b) Additional recognition experiments using actual photographic material.

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(c) Investigation of techniques for improving recognition capability. Partial

2) Study of implementation techniques for:

(a) Computations which use the same arithmetic process at every element in the picture - data independent techniques.
(b) Computational processes which require exploration and dynamic decision - data independent techniques.
(c) Recognition processes and over-all system integration.

B. Modest Program - to be performed in a 12-month period from date of authorization to proceed, and to include only the following elements of the optimum program in (A) above:

Items 1(a), 1(b), 2(a), plus limited effort in 1(c).

C. Minimum Program - to be performed in a 6-month period from date of authorization to proceed, and to include only the following elements of the optimum program in (A) above:

Item 1(b) plus limited effort in 1(a).

Valuable support to the implementation studies under the modest and optimum programs would be afforded by a flying spot scanner to be provided as a Laboratory owned asset. Further discussion of the proposed program and alternates, including material on facilities, personnel, and related projects, along with appendices of published papers, is contained in enclosure (1), Technical Proposal.

We estimate the cost of these programs including fee as follows:

Optimum program	-	STAT
Modest program	-	
Minimum program	-	

A detailed cost breakdown appropriate to each may be found in enclosure (2). Throughout the performance period, we would continue to furnish those reports presently required by Contract STAT including a final report at completion of effort.

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As authorization for one of the above programs to be selected, we would accept an amendment to Contract [redacted] which adds the STAT necessary funding and extends the performance period consistent with the program selected. At the present time, we are performing a limited effort under this contract pending contractual coverage for the no-cost time extension requested in our letter of 30 November 1962 (LEC:mb-861). In this connection, we understand that ONR proposes to extend the Contract at no cost for 6 months rather than 3 months requested by our letter, to allow sufficient time for contract action on this proposal for a funded program. A six month no-cost time extension would be acceptable to us, although we believe it would be most advantageous to ONR and to the continuity of technical effort to fund the selected program at the earliest possible date.

A no-contingent fee statement and a certificate of current pricing data are included in enclosures (3) and (4).

For further technical information, please communicate
STAT with [redacted] Computer Research Department. Contractual matters
STAT will be handled by [redacted] Contracts Department.

STAT

Very truly yours,

[redacted]

Contract Manager

cc: Chief, ONR, Washington 25, D. C.
STAT Attn: [redacted]
Contracts Division

STAT BuWepsRep, [redacted]

Next 2 Page(s) In Document Exempt

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TECHNICAL BACKGROUND PROCUREMENT INFORMATION

I. Contractor

A. Name and address: [redacted] 25X1

25X1 [redacted]

B. Evaluation of previous performance: No previous contracts with NPIC.

Rated "Excellent" by ONR, BuWeps and RADC.

II. Brief description of this procurement: Investigation and development of automatic preprocessing of photo imagery for subsequent automatic recognition by PERCEPTRON. Estimated total amt [redacted] 25X1

A. Deliverable items: Detailed technical reports monthly, quarterly, and annual; fully describing the objectives, nature and results of such investigation and development.

B. Is this procurement for other than a standard, "off the shelf" or slightly modified commercial item? Yes If "yes", is it anticipated that any more of this unit will be procured? NA If so, a complete set of directly reproducible manufacturing drawings and specifications would normally be included in this procurement. Comments:

Not Appropriate

C. Will contract cover a period of more than 90 days? Yes
If "yes", are progress reports desired? Yes If so, indicate frequency, content and number of copies desired:

See "A" above.

D. Is any Government-owned property to be provided to the contractor?

Possibly If so, list and indicate its availability (where, when, etc.) Expendable samples of photo imagery

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E. Is any special tooling involved? No

F. Security:

1. Association with the Sponsor is Unclassified

2. The specifications and/or drawings are Unclassified

3. The item is Not Applicable

4. Contractor personnel known to be aware of this proposed procurement:

25X1

5. Other security information This investigation is of fundamental importance to the entire defense community. Classification restraints should be kept to a minimum. This investigation is a continuation of work
(Continued on back)

III. Reasons for selection of this source. If other sources were considered, indicate results. If no other sources were considered, list the reasons why this firm is considered to be uniquely qualified to perform this work.

Other Sources Considered.

25X1

After considerable investigation, consultation and evaluation, it was decided that CAL was the most qualified for this investigatinn.

IV. Technical contact 25X1

Name Telephone

In the event additional space is required, use the reverse side(s) of this form, with a reference to the item number to which the comment applies.

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5. Other Security information (continued)

25X1 that has been administered by [redacted] of ONR since 1960. [redacted] 25X1
has expressed desire to continue this administration. The common interest in this development expressed by the reconnaissance community further indicates the desirability of maintaining the unclassified status of this project. It is therefore recommended that the contract be negotiated through ONR with the understanding that all technical direction must be initiated or approved by the Plans and Development Staff, NPIC.

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Illustrations to Accompany Presentation On

INVESTIGATION OF PERCEPTRON APPLICABILITY TO PHOTO-INTERPRETATION

(Project PICS)

Washington, D. C.

December 20, 1962

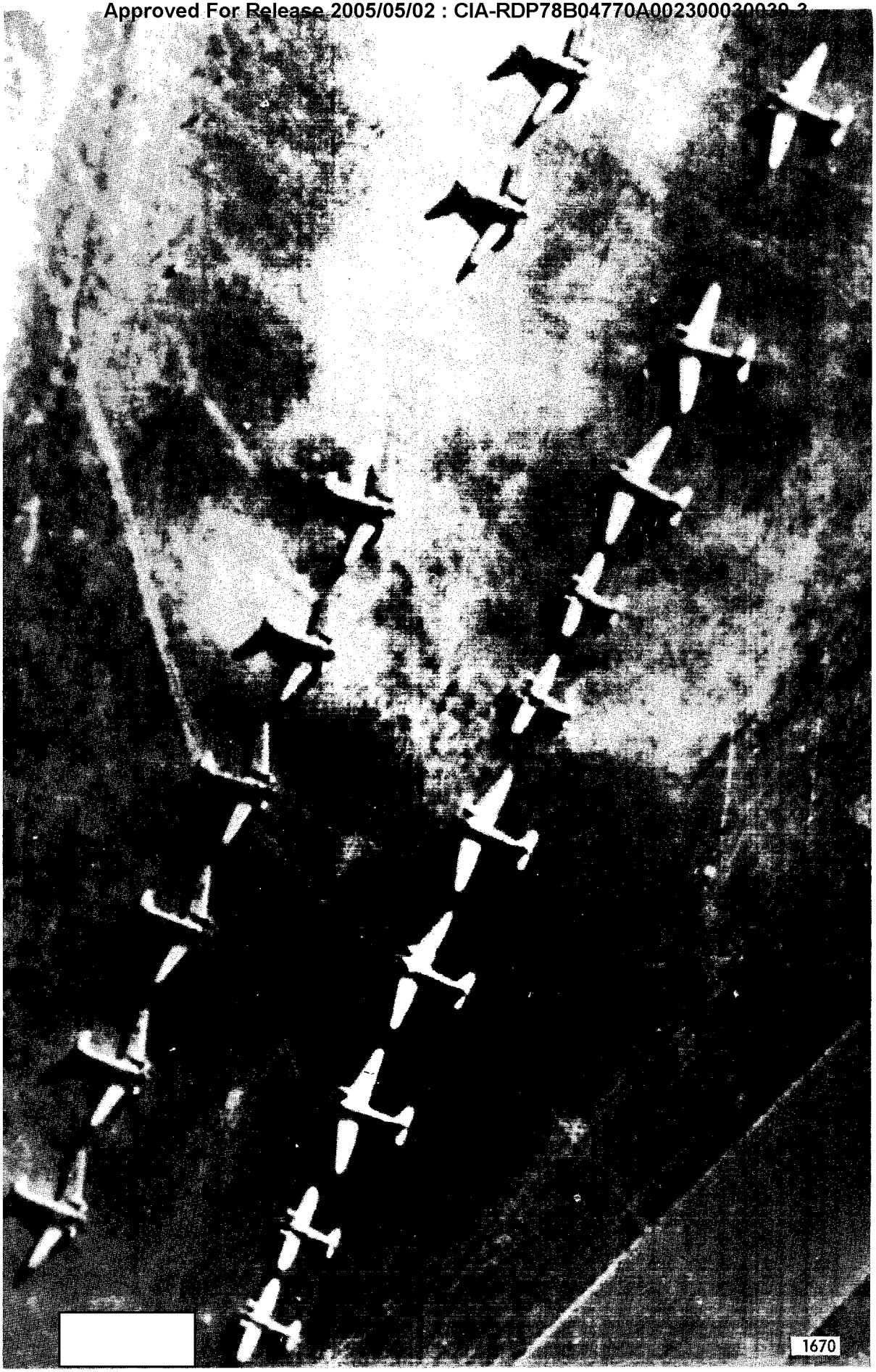

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Figure 1 ORIGINAL PHOTOGRAPH

Figure 2 EDITED VERSION OF FIGURE 1

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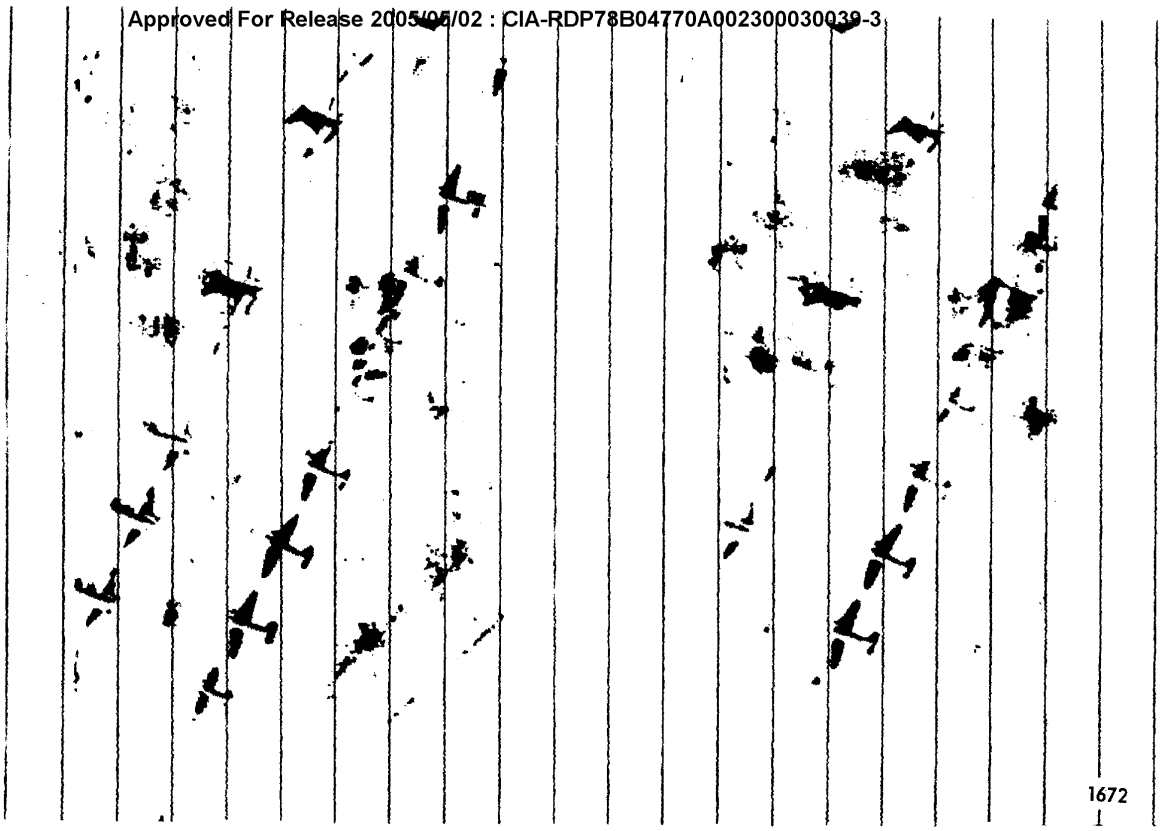

Fig. 3

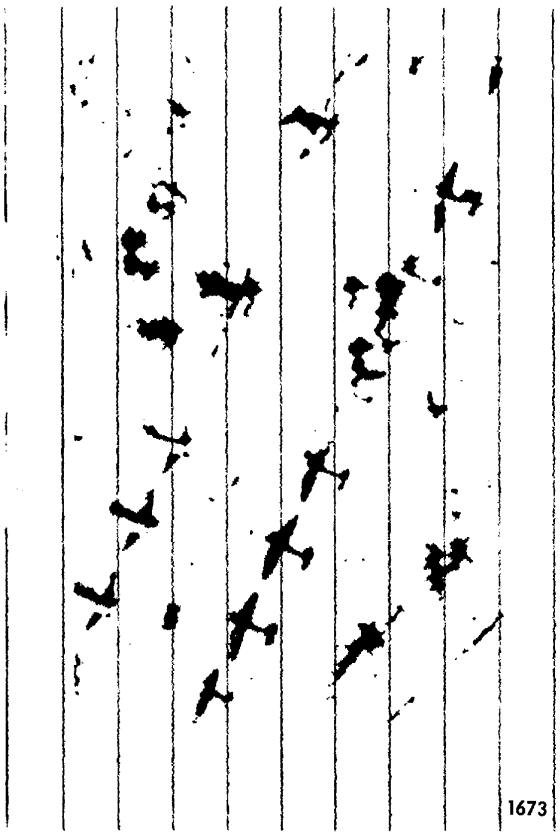

Figure 4 OUTPUT OF GAP FILLER APPLIED TO FIGURE 3(a)

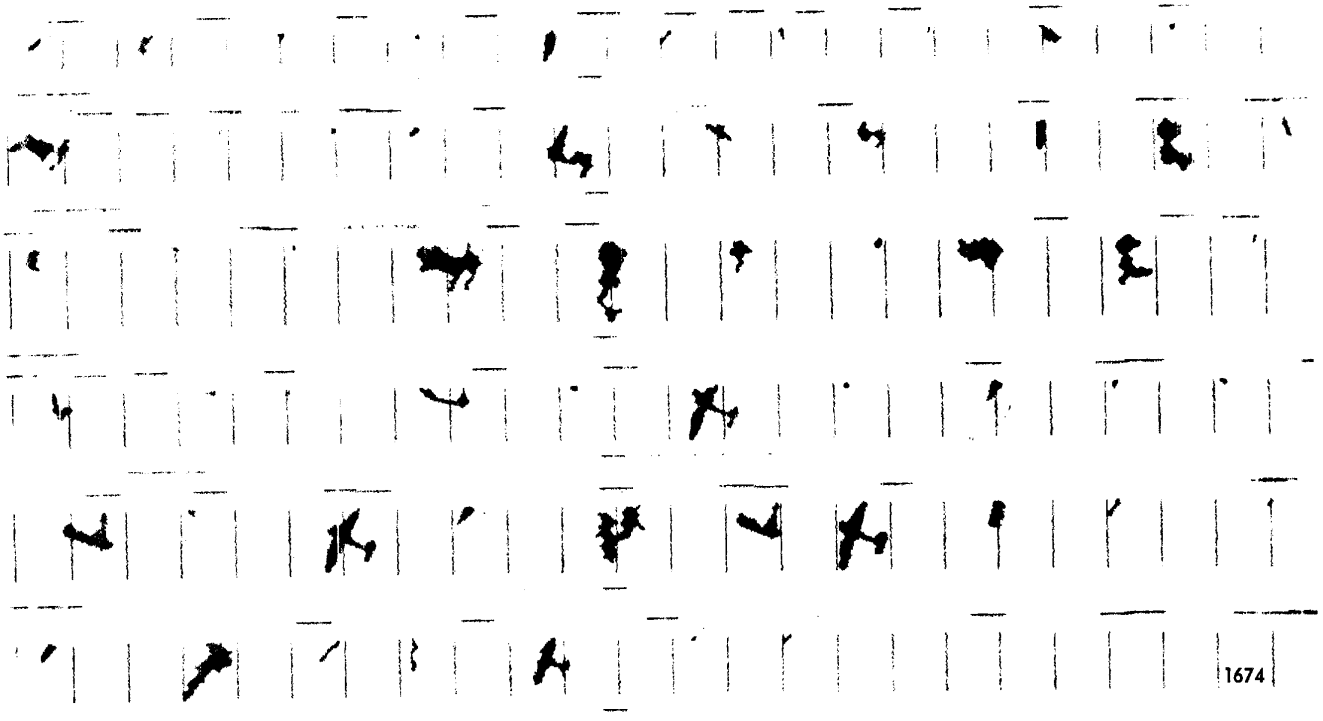

Figure 5 OUTPUT OF ISOLATOR APPLIED TO FIGURE 4

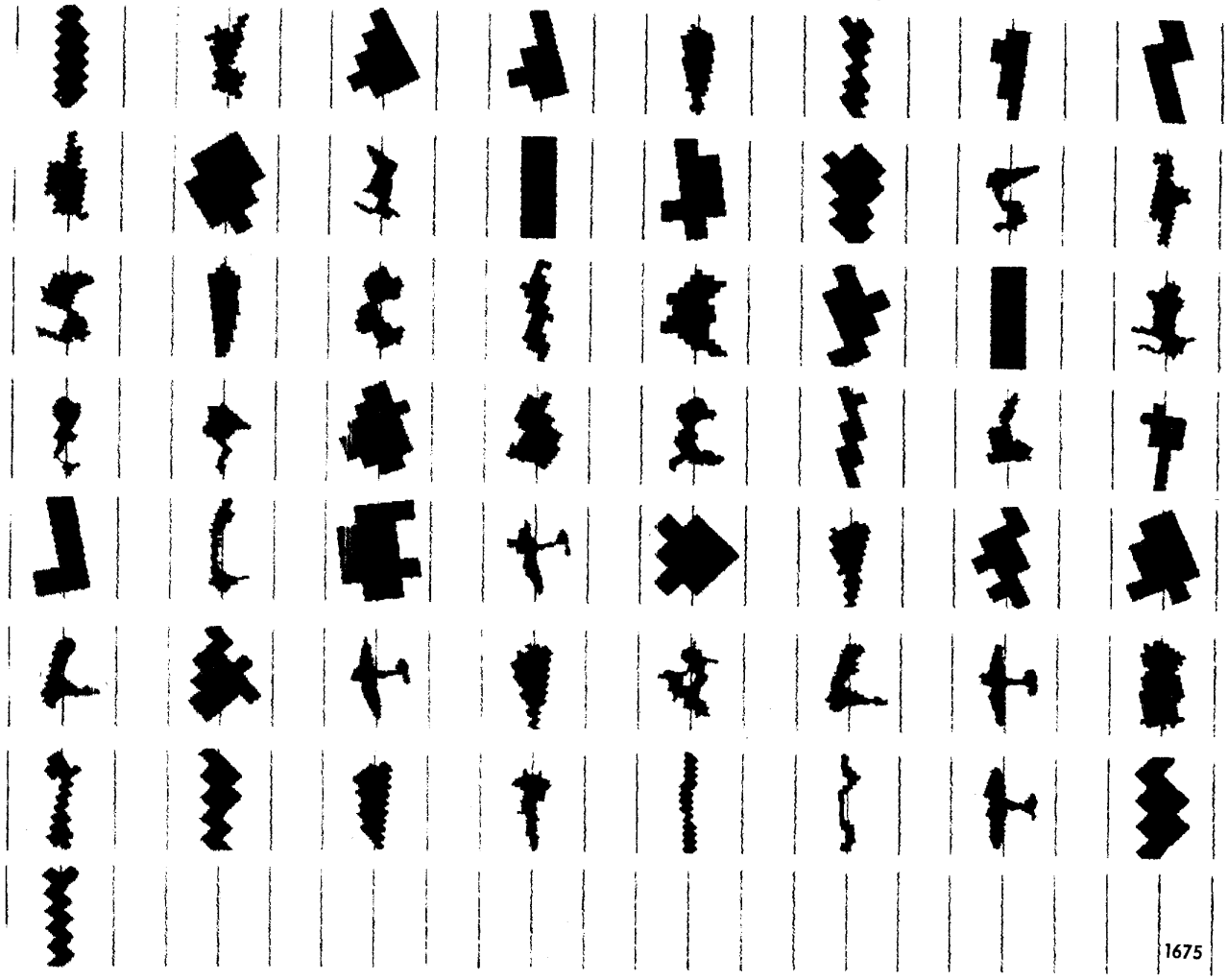

Figure 6 OUTPUT OF STANDARDIZER APPLIED TO FIGURE 5

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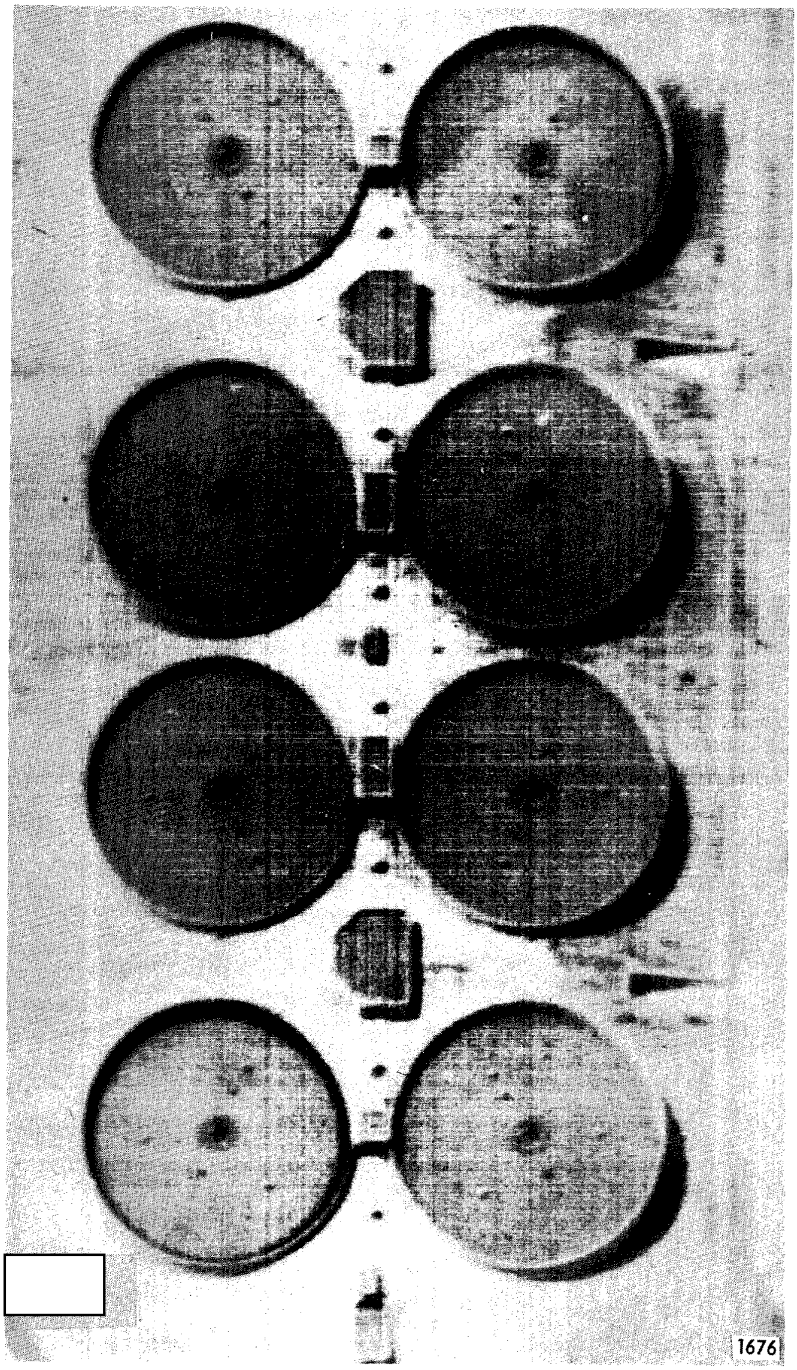

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Figure 7. [illegible]

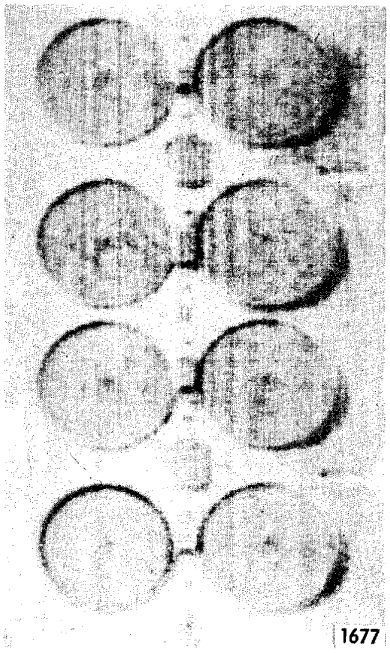

Figure 8 EDITED VERSION OF FIGURE 7

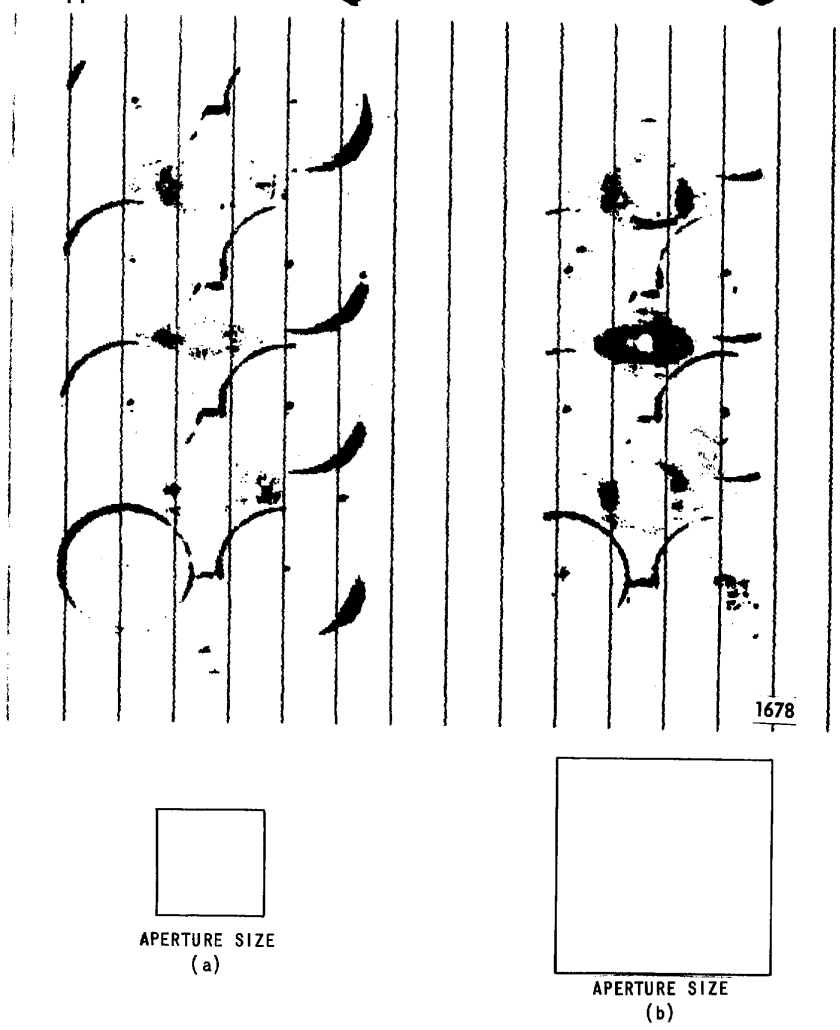

Figure 9 ANNULAR FILTER OUTPUT FOR TWO APERTURE SIZES

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Figure 10(a) OUTPUT OF KOLMOGROV-SMIRNOV FILTER APPLIED TO FIGURE 8

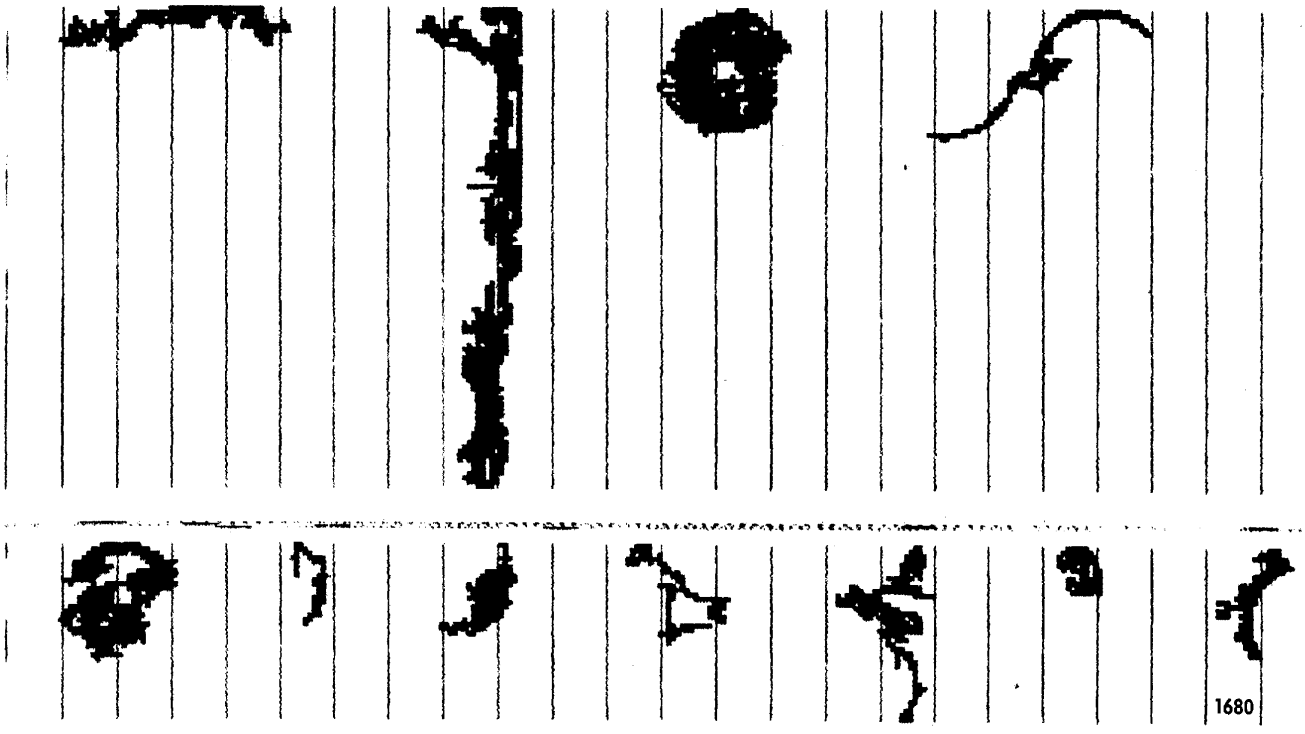

Figure 10(b) OUTPUT OF KOLMOGROV-SMIRNOV FILTER APPLIED TO FIGURE 8

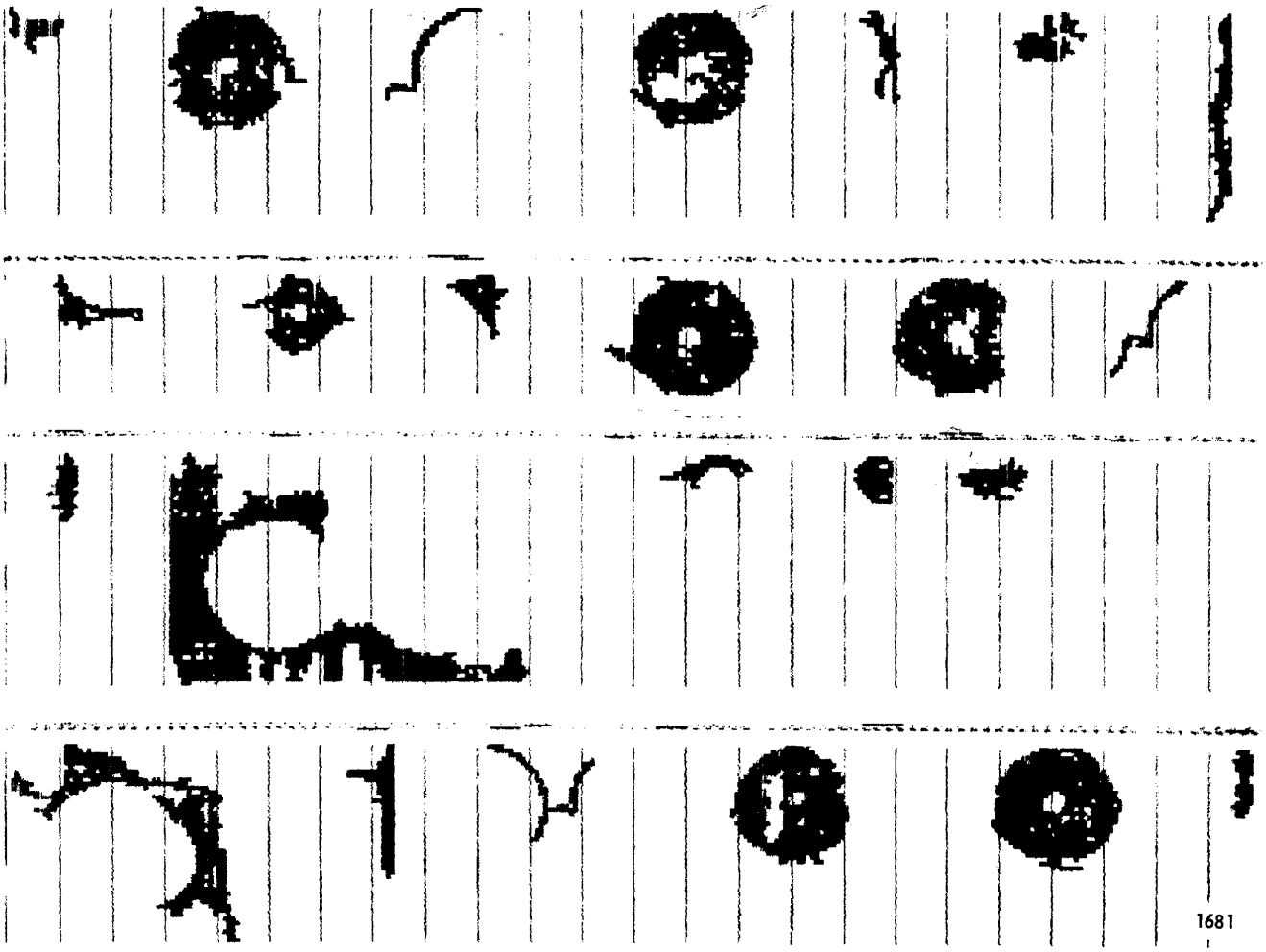

Figure 10(c) OUTPUT OF KOLMOGROV-SMIRNOV FILTER APPLIED TO FIGURE 8

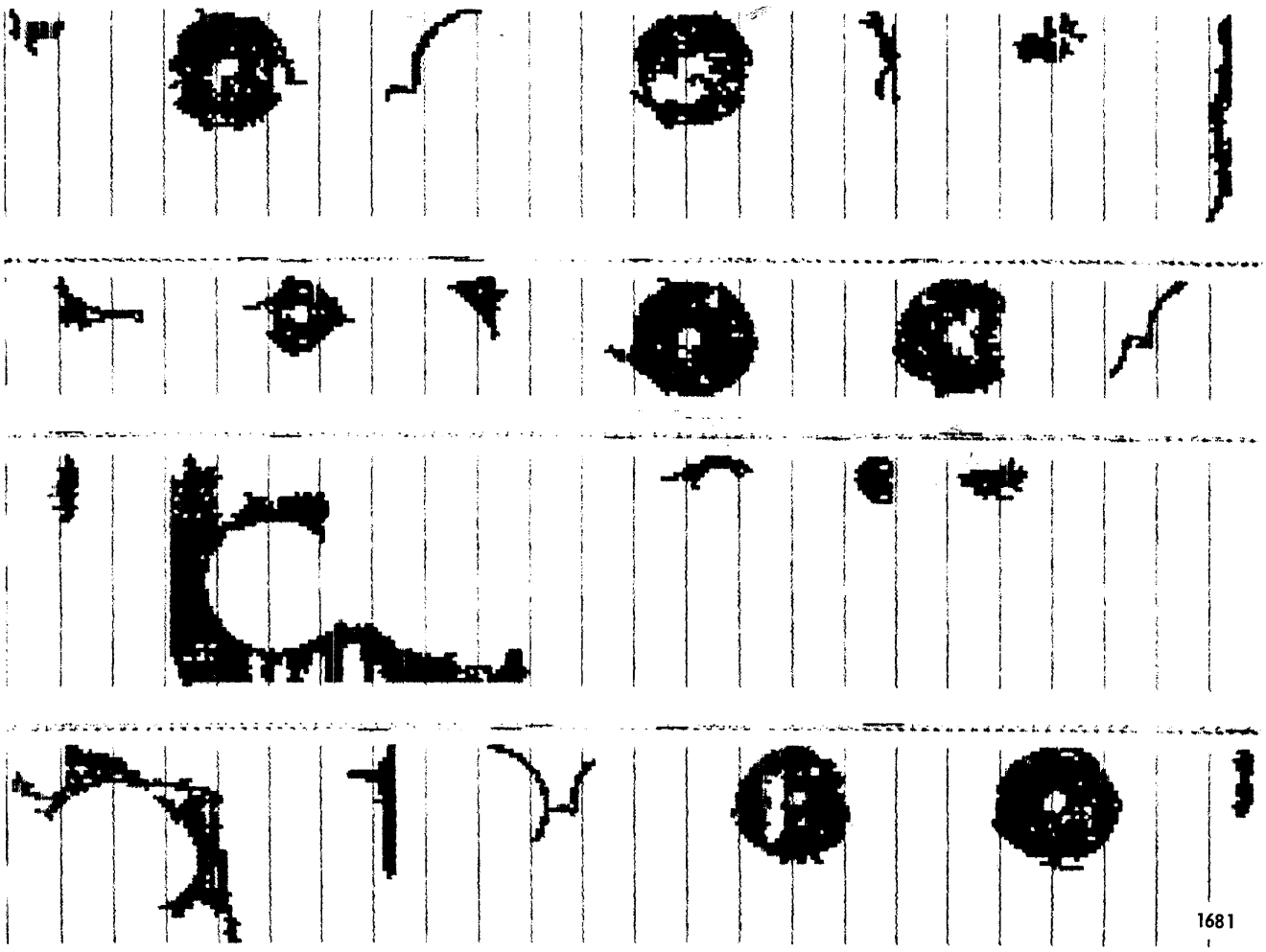

Figure 10(c) OUTPUT OF KOLMOGROV-SMIRNOV FILTER APPLIED TO FIGURE 8

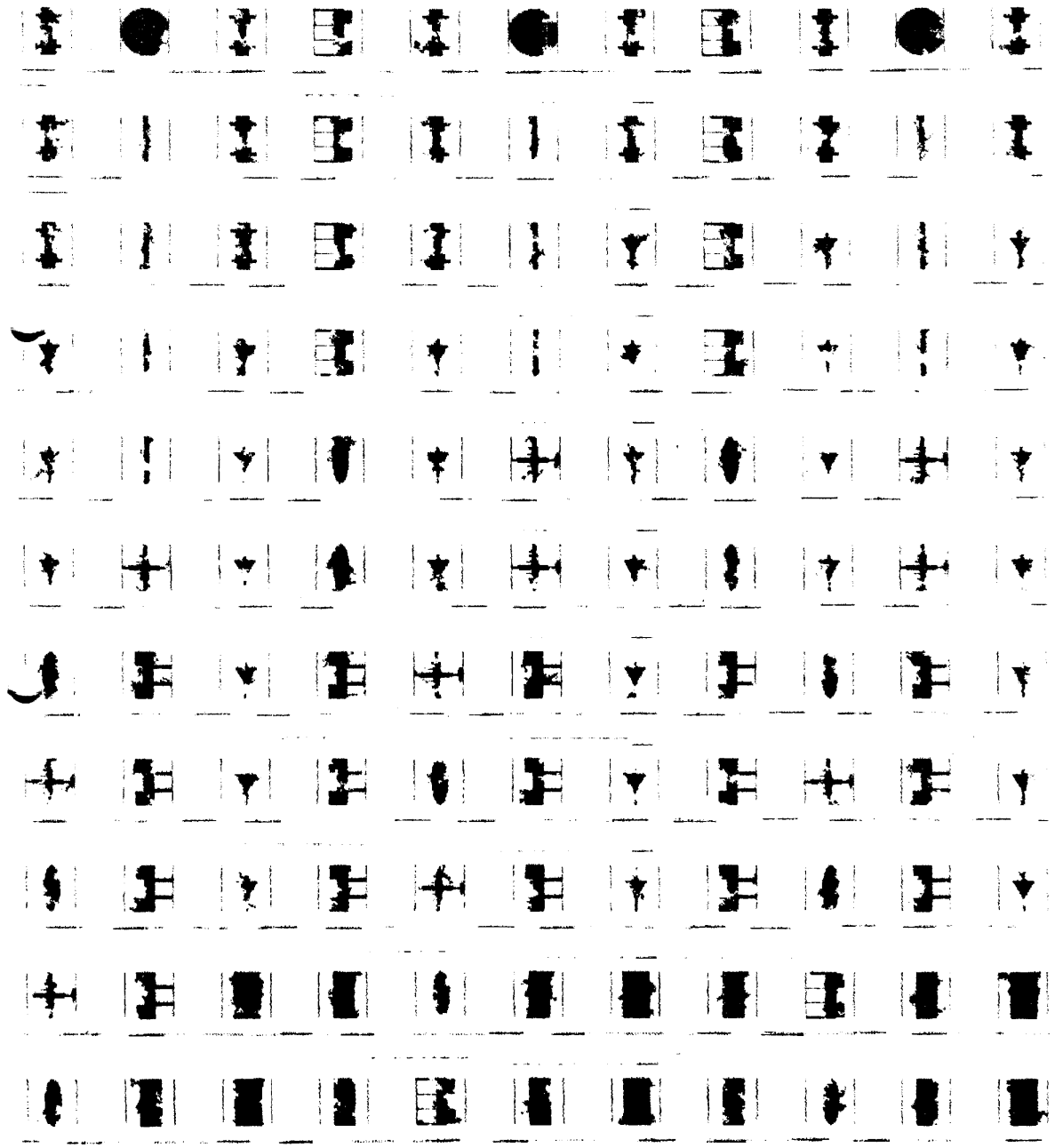

Figure 11 SAMPLE OF OBJECTS USED IN RECOGNITION EXPERIMENTS

RESULTS OF RECOGNITION EXPERIMENT

Synthesized Objects

Correct Pattern Classification	Total Number	Number Correctly Classified	Number Incorrectly Classified	% Recognition
TU 104	60	60	0	100.0
IL 18	60	60	0	100.0
LA 60	60	60	0	100.0
F 102	60	60	0	100.0
SHIPS	60	59	1	98.3
BLDGS	90	86	4	95.5
TANKS	60	59	1	98.3
Object Total	450	444	6	98.7
Other	270	262	8	97.0

Object Detection Probability = .987

False Alarm Probability = .030

COMPLETE RECOGNITION RESULTS

Correct Classification ↓	Recognized As: TU 104	IL 18	LA 60	F 102	SHIPS	BLDGS	TANKS	OTHER	REJECTED
TU 104	60								
IL 18		60							
LA 60			60						
F 102				60					
SHIPS					59				1
BLDGS						86		4	
TANKS							59	1	
OTHER					2	6		262	